REMARKS

Claims 1-7 and 17-20 were examined. No claims are amended or canceled. Claims 1-7 and 17-20 remain in the application.

The Patent Office rejects claims 1-4, 6-7 and 17-20 under 35 U.S.C. §102(b). Claim 5 is rejected under 35 U.S.C. §103(a). Reconsideration of the claim rejections is respectfully requested in view of the following remarks.

A. 35 U.S.C. §102(b): Rejection of Claims 1-4 & 6-7

The Patent Office rejects claims 1-4 and 6-7 under 35 U.S.C. §102(b) as anticipated by "Role of N_2 Addition on CF_4/O_2 Remote Plasma Chemical Dry Etching of Polycrystalline Silicon," Matsuo et al. (Matsuo).

Independent claim 1 describes an apparatus including a first reaction chamber, a gas source coupled to the first reaction chamber to supply a nitrogen gas to the first reaction chamber and an excitation of energy source coupled to the first reaction chamber to generate a nitrogen plasma comprising ions and radicals from the nitrogen gas. The apparatus also includes a second reaction chamber adapted to have a substrate for film formation and a site in the second reaction chamber. The first reaction chamber is coupled to the second reaction chamber and separated from the substrate site by a distance equivalent to the lifetime of the ions at a plasma generation rate such that the radicals react with the substrate in a film conversion step.

Matsuo describes experimental etching procedures, specifically, chemical dry etching of silicon. Matsuo describes generating a microwave plasma in a plasma applicator coupled to a processing chamber for an etch process. The plasma is separated from the processing chamber by tubing of various lengths (0 to 125 centimeters). Matsuo describes etching silicon in a CF_4 plasma with oxygen (O_2) and/or nitrogen (N_2) addition.

In order to anticipate a claim, the relied upon reference must disclose every limitation of the claim. Matsuo does not describe (1) a second reaction chamber adapted to house a substrate for film formation; or (2) that the first reaction chamber is separated from a substrate site by a distance equivalent to the lifetime of nitrogen ions at a plasma's generation rate such that nitrogen radicals react with the substrate in a film conversion step. Matsuo describes etching, not film formation. Matsuo does not say that nitrogen is incorporated in any film formation layer, even a reaction layer formed as part of a chemical dry etching process ("even though nitrogen plays a profound role in the etching of silicon, it is not incorporated in a stable reaction layer." III.C.3 (1806)). Thus,

Matsuo does not describe specifying a distance between its plasma applicator and its processing chamber so that nitrogen radicals react with the substrate. Such a limitation also cannot be inherent in Matsuo because Matsuo clearly states that nitrogen is not involved in its reaction layer (plasma or ions).

The separation between the first reaction chamber and a substrate site in claim 1 is a structural limitation set by a distance equivalent to the lifetime of ions at a plasma generation rate such that radicals (nitrogen radicals) react with a substrate in a film conversion step. The Patent Office compares tube lengths (12 in.) noted in both references. Applicants question whether similar tube lengths in significantly different environments would produce similar results. Applicants' skepticism is supported by Matsuo's statement that nitrogen is not present in the reaction layer (for etching). Applicants specifically request that the Patent Office provide some evidence or teaching that allows it to assume the separation between Matsuo's plasma applicator and a substrate site provides nitrogen radicals available to react with a substrate.

In the interest of seeking allowance of the application, Applicants also present a rebuttal to any obviousness rejection in view of Matsuo. Independent claim 1 is prima facie not obvious over Matsuo for the reasons cited above. Similarly, there is no motivation in Matsuo for separating a plasma from a silicon etching environment in the presence of nitrogen. In fact, Matsuo indicates that, in the presence of nitrogen, zero tube length (i.e., no separation between plasma applicator and etching chamber) is best:

Section III.A.2 and Figure 4 (page 1803): Teach that zero tube length yields the highest etch rate when nitrogen gas is added to the existing to an existing plasma discharge.

Section III.C.4 (page 1809): Describes an etch reaction layer thickness for various tube lengths. Concludes:

> "For discharges devoid of oxygen, the behaviors of the reaction layers are similarly, both with and without admixed nitrogen, constant with increasing quartz tube length."
>
> When both N_2 and O_2 are admixed into a CF4 discharge, "the thickness stayed constant with increasing quartz tube length."

Section IV.B (page 1812): Describes the etch rate and atomic fluorine concentration for various tube lengths, Matsuo shows that, in the presence of nitrogen, as the tube length is increased the etch rate drops off.

According to the configuration of claim 1, whereby the first reaction chamber and a substrate (e.g., wafer) site are separated by a distance equivalent to the lifetime of ions at a plasma generation rate, only radicals reach a wafer for reaction. Any ions generated in the plasma are neutralized due to the length of, for example, a tube or conduit. See Application, page 4, lines 16-18. According to this configuration, charged particles of a plasma are not available to sputter a wafer and thus, by way of structural limitations of claim 1, a relatively damage free dielectric layer may be produced. See Application, page 15, lines 10-17. Matsuo does not teach or suggest such a result.

For the above stated reasons, claim 1 is not anticipated nor obvious over Matsuo. Claims 2-4 depend from claim 1 and therefore include all the limitations of that claim. For at least the reasons stated with respect to claim 1, claims 2-4 are not anticipated by nor obvious over Matsuo.

Independent claim 6 describes an apparatus including a first reaction chamber; means for supplying a nitrogen gas to the first reaction chamber; and means for generating a plasma from the nitrogen gas. The apparatus also includes a second chamber having means for housing a substrate for film formation processing and means for providing the plasma to the reaction chamber substantially free of ions such that radicals from the plasma react with a substrate in a process conversion step.

Claim 6 is not anticipated by Matsuo because Matsuo does not describe, among other things, means for providing a plasma (of nitrogen) to a reaction chamber substantially free of ions such that nitrogen radicals react with a substrate in a process conversion step. Such means is a structural limitation of the apparatus in that, in one sense, it establishes the relationship between the generated plasma and a second reaction chamber. Matsuo does not describe introducing a nitrogen plasma to a chamber substantially free of ions. Matsuo also does not describe providing nitrogen radicals that may react with a substrate in a process conversion step.

Applicants also believe that claim 6 is not obvious over Matsuo, because Matsuo provides no motivation for including means for providing a plasma to a second reaction chamber in such a way that radicals of the nitrogen reacts with a substrate in a process conversion step. As noted above with respect to claim 1, to the extent that a nitrogen plasma is generated in Matsuo, Matsuo sees no benefit from separating, such as by a quartz or teflon tube, a plasma generation site from an etching chamber.

Independent claim 6 is not anticipated by nor obvious over Matsuo. Claim 7 depends from claim 6. For at least the reasons stated with respect to claim 6, claim 7 is not anticipated by nor obvious over Matsuo.

B. <u>35 U.S.C. §102(b): Rejection Claims 17-20</u>

The Patent Office rejects claims 17-20 under 35 U.S.C. §102(b) as anticipated by U.S. Patent No. 5,082,517 issued to Moslehi (<u>Moslehi</u>).

Independent claim 17 relates to a system including a first chamber; a nitrogen gas source coupled to the first chamber and an energy source coupled to the first chamber. The system also includes a second chamber configured to house a substrate for film formation processing and a system controller configured to control the introduction of a gas from the gas source into the first chamber and to control the introduction of an energy from the energy source. The system also includes a memory coupled to the controller and instructions for controlling the gas source and the energy source to convert a portion of a gas supplied by the gas source into a plasma. The first reaction chamber is separated from the second reaction chamber by a distance equivalent to the lifetime of ions at a plasma generation rate such that radicals react with a substrate in the second chamber in a film conversion step.

Independent claim 17 is not anticipated by <u>Moslehi</u>, because <u>Moslehi</u> does not describe a system including a first reaction chamber and a second reaction chamber <u>that are separated by a distance equivalent to the lifetime of ions at a plasma generation rate</u> such that radicals react with a substrate in the second chamber in a film conversion step. <u>Moslehi</u> teaches preferably introducing both charged and neutral species to a process chamber. Independent claim 17 is directed at minimizing "charged" species by the structural limitation of separating a plasma generation chamber ("first chamber") from a substrate site by distance equivalent to a lifetime of ions. The Patent Office relies on column 4, lines 9-14 of <u>Moslehi</u> as teaching this language. The cited language does not teach the structural limitation regarding the relationship between a first chamber in a substrate site as required by claim 17. This language only describes a capability of a plasma density controller. Similarly, the Patent Office relies on column 11, lines 54-63 of <u>Moslehi</u>. The cited language describes a <u>plasma generation tube</u> of a certain dimension not a separation between the plasma generation tube and a processing chamber.

The plasma's generation to the cited language does not describe a relationship between the plasma generation tube and a process chamber (e.g., the distance between the plasma generation tube and a process chamber).

In terms of obviousness, <u>Moslehi</u> does not provide any motivation for a system where a first reaction chamber and a second reaction chamber is separated by a distance equivalent to the lifetime of nitrogen ions at a plasma generation rate, because <u>Moslehi</u> prefers introducing both charged and neutral species to a reaction chamber.

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Independent claim 17 is not anticipated by Moslehi, because Moslehi does not describe a system including a first reaction chamber and a second reaction chamber that are separated by a distance equivalent to the lifetime of ions at a plasma generation rate such that radicals react with a substrate in the second chamber in a film conversion step. Moslehi teaches preferably introducing both charged and neutral species to a process chamber. Independent claim 17 is directed at minimizing "charged" species by the structural limitation of separating a plasma generation chamber ("first chamber") from a substrate site by distance equivalent to a lifetime of ions. The Patent Office relies on column 4, lines 9-14 of Moslehi as teaching this language. The cited language does not teach the structural limitation regarding the relationship between a first chamber in a substrate site as required by claim 17. This language only describes a capability of a plasma density controller. Similarly, the Patent Office relies on column 11, lines 54-63 of Moslehi. The cited language describes a plasma generation tube of a certain dimension not a separation between the plasma generation tube and a processing chamber.

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In terms of obviousness, Moslehi does not provide any motivation for a system where a first reaction chamber and a second reaction chamber is separated by a distance equivalent to the lifetime of nitrogen ions at a plasma generation rate, because Moslehi prefers introducing both charged and neutral species to a reaction chamber.

> "Consequently, there is a need for a device that adjustably controls the plasma-generating electromagnetic power that a fabrication process gas receives to product a processed plasma consisting of activated charged and neutral species."

Col. 2, lines 37-41.

As noted above with respect to Matsuo, by separating a first reaction chamber and a second reaction chamber by a distance equivalent to the lifetime of ions at a plasma generation rate, only radicals reach a wafer for reaction. Charged particles (e.g., ions) are not available to sputter a substrate and thus a relatively damage free dielectric layer may be produced. Moslehi does not teach or suggest such a result.

For the above stated reasons, claim 17 is not anticipated by Moslehi. Claims 18-20 depend from claim 17 and therefore contain all the limitations of that claim. For at least the reasons stated with respect to claim 17, claims 18-20 are not anticipated by Moslehi.

Applicants respectfully request that the Patent Office withdraw the rejection to claims 17-20 under 35 U.S.C. §102(b).

C. 35 U.S.C. §103(a): Rejection of Claim 5

Claim 5 is rejected under 35 U.S.C. §103(a) as obvious over Matsuo in view of U.S. Patent No. 6,130,118 issued to Yamazaki (Yamazaki). Yamazaki is cited for describing a plasma reaction apparatus for film deposition.

Claim 5 depends from claim 1 and therefore contain all the limitations of that claim. Accordingly, claim 5 is not obvious over the cited references because the references do not disclose or provide any motivation for an apparatus including a first reaction chamber coupled to a second reaction chamber having a substrate site separated by a distance equivalent to the lifetime of nitrogen ions at a plasma generation rate.

Applicants respectfully request that the Patent Office withdraw the rejection to claim 5 under 35 U.S.C. §103(a).

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CONCLUSION

In view of the foregoing, it is believed that all claims now pending patentably define the subject invention over the prior art of record and are in condition for allowance and such action is earnestly solicited at the earliest possible date.

Respectfully submitted,
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CERTIFICATE OF TRANSMISSION:
I hereby certify that this correspondence is being transmitted via facsimile addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231 on January 23, 2003.

Nedy Calderon 1/23/03
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